

A NEW MACROSTACHYA FROM THE CARBONIFEROUS OF ILLINOIS

BY
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ALTHOUGH an extensive literature concerning calamarian cones has been developed during the past fifty years, only meager information about *Macrostachya* is available. Well-preserved specimens of cones of fossil plants are rather rare, and frequently the fragmentary nature of larger forms makes investigation difficult. *Macrostachya* belongs to articulated plants remotely related to living Equisetales.

The specimen described in this study was collected in the strippings of the Wilmington mines, Will County, Illinois. These coal workings are an extension of the "Mazon Creek" beds. The specimens occur in typical iron-stone nodules. Mr. Frederick O. Thompson, the collector and donor, has presented his extensive collections to the Botanical Museum of Harvard University. Mr. Thompson has succeeded in gathering 11,000 specimens from Will County, and although calamarian cones are relatively common only two are referable to *Macrostachya*.

The complete specimen, number 15602, was first studied in the round, and then investigated by the "peel" method.

This peel method may be described briefly. The surface of the specimen is washed carefully with water and then is etched with a two percent solution of hydrochloric acid. Following the application of acid, the surface is again washed with water in order to remove excess acid and salts in solution. After the specimen is dry, a solution of nitrocellulose in butyl acetate is poured over the etched surface. Within six hours the nitrocellulose hard-

ens into a tough, pliable, permanent, transparent film. This film or "peel" is peeled away from the specimen. The dried peel contains a replica of the cellular detail which is composed of black or brown carbon from the original cellulose. Desired portions are mounted, unstained in the usual cytological method, with balsam in xylol. Such preparations may be studied with a magnification up to 1000 diameters.

Numerous peels can be made on a single specimen without destroying the specimen itself. In this study eight peels were made from the holotype.

In general practice all macrostachyan cones of large size and compact whorls are identified with *Macrostachya infundibuliformis* (Brongniart) Schimper. The species is not only poorly defined, but also so broadly interpreted that several different species are included in it. Despite this confusion it was evident at once that the specimens from Illinois were distinct. The whorls contain 30 to 36 sterile bracts, whereas *Macrostachya infundibuliformis* contains only 20. In addition, the sporangia contain large isospores, whereas *M. infundibuliformis* is believed to be heterosporous. There are other specific differences such as the shape of the bracts and the proportions of the cone. There is no reason for the establishment of a new generic designation.

MACROSTACHYA *Schimper*

Traité de Paleontologie végétale vol. 1. p. 332.
1869.

Macrostachya Thompsonii *Darrah sp. nov.*

Cone large, 210 mm. long; whorls 5-7 mm. apart, except at apex where they are compact; each whorl is composed of 30-36 bracts; there are 50-53 whorls; each bract is mucronate with 1, 2, and even 3 teeth. Sporangia are borne as in *Calamostachys*. The plant is isospo-

rous; the large spores measure 350–400 μ . in diameter; usually collapsed; smaller, undernourished spores occasionally present. Shape of the cone elongate, expanding from a pedicle 6 mm. wide, gradually to 30 mm. in the middle third, continuing until near the apex where it tapers suddenly to a rounded summit.

I have the honor to name this specimen *Macrostachya Thompsonii* in recognition of Mr. Thompson's continued interest in paleobotany and his generosity to the Botanical Museum of Harvard University.

Lesquereux believed that *Macrostachya infundibuliformis* occurs in the Mazon Creek flora. His specimen is a poorly preserved *Macrostachya Thompsonii*. Lesquereux¹ figured a specimen from Cannelton, Beaver County, Pennsylvania as *M. infundibuliformis*. It differs from Brongniart's² species but falls within the concept of Schimper³. It is probably an unnamed species. Nothing is known of its internal structure, so that a new name would not help the problem. Lesquereux also united with Schimper's *M. infundibuliformis*, *Asterophyllites tuberculata* Lesquereux⁴, and *Asterophyllites aperta* Lesquereux⁵. Both of these species are probably valid.

The most comprehensive discussion of *Macrostachya*, especially *M. infundibuliformis* is to be found in the monograph on Steinkohlen-Calamarien by Weiss⁶. Figure 1 on plate VI is frequently copied by paleobotanists (Gothan⁷, Scott⁸) and is considered to be the "typical" form

¹ Lesquereux: Coal Flora, p. 60. pl. 13. f. 17. 1879.

² Brongniart: Histoire Vég., foss. p. 119. pl. 12. f. 14–16. 1828.

³ Schimper: Paleontologie Végétale, v. 1. p. 333. 1869.

⁴ Lesquereux: Geol. Penna., p. 852. 1858.

⁵ Lesquereux: Geol. Penna., p. 852. pl. 1. f. 4. 1858.

⁶ Weiss: Steink. Calam., p. 71. pl. 6. f. 1–4. 1876.

⁷ Gothan: Leitfossilien III, p. 117. f. 102. 1923.

⁸ Scott: Studies, 3rd. Ed., v. 1. p. 65. f. 33. 1920.

of the species. On plate XVIII, figures 1, 3, and 4, Weiss illustrates a slender, lax variety called *Solmsii*. However, its reference to *Macrostachya infundibuliformis*, even as a variety is rather dubious. Certainly the robust *Macrostachya Thompsonii* with its thickened bracts is distinct.

Bischoff⁹ figured a poor specimen from Bronn's collection under the name of *Equisetum infundibuliforme*. It is not referable to *Macrostachya infundibuliformis*. In the collections of the Botanical Museum, there are three specimens from Bronn's collection (number 10432). They are the type specimens.

Their identity is authenticated by the following data on Bronn's original label:

Equisetum infundibuliforme Bronn et Bischoff 1827
Steinkohlengebirge, St. Ingbert's.

As Weiss¹⁰ suggested they belong to *Cingularia typica* Weiss. Incidentally in a foot-note (loc. cit. p. 93) he says "Das Original soll mit der Bronnschen Sammlung nach dem Tode des Besitzers nach Amerika gewandert sein." Bronn's collection was purchased by Harvard University in 1859.

Brongniart¹¹ published a description of *Macrostachya infundibuliformis* under the name of *Equisetum infundibuliforme*. He extended Bronn's concept to include what subsequently became known as the "typical" plant. Brongniart's memoirs were widely used, while Bischoff's paper escaped the notice of most paleobotanists. Thus Brongniart's *E. infundibuliformis* is conserved, although Bronn's species has priority. Thus the correct designa-

⁹ Bischoff: Krypt. Gewächse, p. 52. pl. 6. f. 4. 1828.

¹⁰ Weiss: Steink. Calam., 1876.

¹¹ Brongniart: Hist. Vég. foss., p. 119. pl. 12. f. 14-16. 1828. f. 14 is a copy of Bronn's type.

tion is *Macrostachya infundibuliformis* (Brongniart, non Bronn) Schimper.

The identity of *Macrostachya infundibuliformis* is further complicated by the dual interpretation of Renault¹². Renault figured an elongate strobilus with a typical incurved pedicle (pl. 18. fig. 2) but the detail is too poor to show any structure. He also figured and described (pl. 19. fig. 6, 7, 8) a specimen from Autun, France as *Macrostachya infundibuliformis?*. This specimen was sili-cified and suitable for the grinding of thin sections. From rather poor preparations he deduced that the verticils were composed of 20 bracts which are distantly placed—as much as 5 mm.—and that numerous large “macrospores” were present. Renault also included in this species numerous impressions from Permian and Upper Carboniferous deposits. There is little evidence to demonstrate that Renault’s figured specimens were identical.

Renault¹³ also studied carbonized cones of a *Macrostachya* found with *Calamites* stems in Autun. With unsatisfactory methods, he was able to show that the cone was heterosporous, with both microsporangia and megasporangia in the same strobilus. Renault’s description and interpretation is not clear. *Calamostachys Binneyana*, although homosporous, sometimes shows abortive or undernourished spores, and may give the appearance or being heterosporous. *Calamostachys Casheana* on the other hand, is heterosporous, but even in this species the same abortion of spores occurs. A similar sacrifice of certain spores is to be observed in *Macrostachya Thompsonii*.

The occurrence of large spores in *Macrostachya Thompsonii* may indicate that the plant was heterosporous, but that the microsporangia and megasporangia

¹² Renault: Cours de Bot. foss., p. 121. 1882.

¹³ Renault: Notice sur les Calamariées, pt. III. 1898.

were borne in separate cones. However, there is no evidence to support this possibility.

It will be observed that in many respects *Macrostachya Thompsonii* resembles the better-known genus *Calamostachys*. At the same time the gross appearance of the cone is very unlike the smaller, lax, not imbricated *Calamostachys*.

Huttonia spicata Sternberg¹⁴ is in general form similar to *Macrostachya*. In its structure, however, it appears to be a typical *Palaeostachya*¹⁵. The resemblance of *Macrostachya* to structural plans known under other generic names, may indicate that *Macrostachya* is an unnatural group of large cones of which no structure is known. In this case, as soon as internal anatomy is known, the several species would be transferred to either *Calamostachys* or *Palaeostachya*. This is probably an extreme view which cannot be defended.

In the recent discussions of the phylogeny of the sphenopsids or articulates (Browne¹⁶, Zimmerman¹⁷) no mention is made of *Macrostachya*. It will be seen from the foregoing account that *Macrostachya* in no way alters the conventional interpretations concerning the calamarian cone.

At this time it is not possible to determine the parent-plant of *Macrostachya Thompsonii*. Among the Mazon Creek plants there are many detached parts of *Calamites*. All of the calamarian cones (*Macrostachya*, *Calamostachys*, *Palaeostachya*, *Cingularia*) are borne by *Calamites*. The following "species" are known from the Mazon Creek flora:

¹⁴ Hirmer: Handbuch, p. 455. 1927.

¹⁵ Jongmans: Anleitung Bestimmung Karbonpflanzen, p. 354. 1911.

¹⁶ Browne: Ann. Bot., v. 41. p. 301-320. 1926.

¹⁷ Zimmermann: Phylogenie der Pflanzen, 1930.

EXPLANATION OF THE ILLUSTRATION

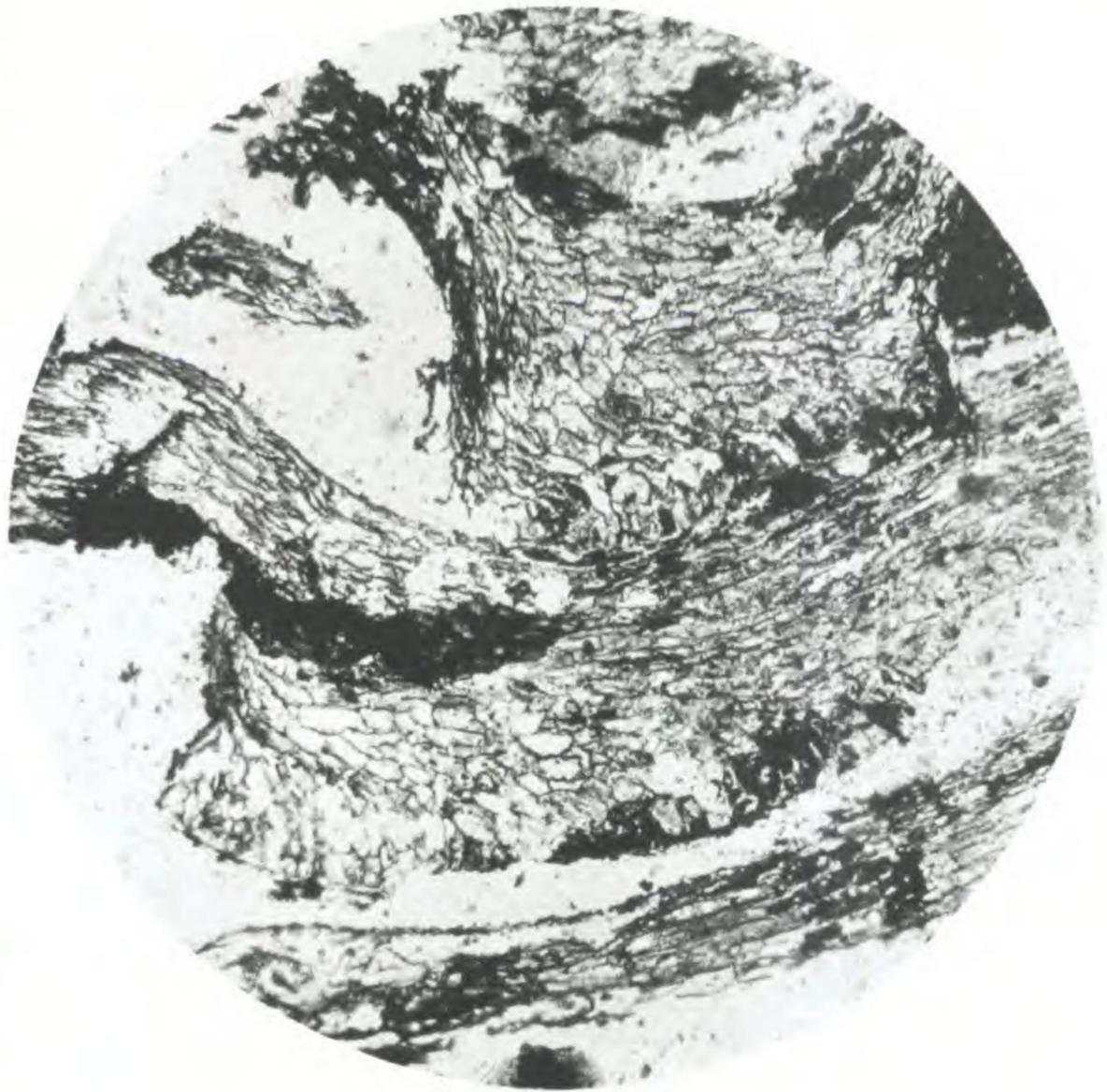
MACROSTACHYA THOMPSONII *Darrah*. Heliotype reproduction from a photograph of the type specimen, three fourths natural size. Number 15602 Botanical Museum Collection.



EXPLANATION OF THE ILLUSTRATIONS

MACROSTACHYA THOMPSONII *Darrah*. Figure at upper left. Heliotype reproduction of a photograph of a nitrocellulose peel from the reverse half of the type specimen, showing central axis and sterile bracts in longitudinal section at top, and numerous sporangia in the middle region. One half natural size.

Figure at lower right. Heliotype reproduction from a photomicrograph of a nitrocellulose peel from the type specimen, showing two sterile bracts and the remnants of a sporangium. Magnified 44 times.



<i>Stems</i>	<i>Foliage</i>	<i>Cones</i>
Calamites Suckowii	Annularia stellata	Macrostachya Thompsonii
C. carinatus	A. radiata	Calamostachys Solmsii
C. ramosus	A. sphenophylloides	C. magna
	Asterophyllites equisetiformis	C. germanica
		Palaeostachya sp.

In other words, there are three “species” of stems, four of foliage, and five of cones. The various “generic” designations indicated above are form-genera. In the study of fossil plants, the paleobotanist has to contend with fragmentary and detached specimens. Hence a cone will receive generic and specific names, as will a stem and a leaf-whorl. Ultimately the discovery of a more complete specimen may bring together these various parts under one “biological species.” This may seem confusing, but in practice it has been useful and simple. The foliage of *Macrostachya Thompsonii* is an *Annularia*, because the *Asterophyllites* leaves from Mazon Creek belong to a *Calamostachys*, probably *C. magna*. The second specimen of *Macrostachya Thompsonii* (number 15608) is accompanied in organic attachment with a poorly preserved, slightly modified, *Annularia*—probably Jongman’s *Annularia stellata americana*.¹⁸

The species here named *Macrostachya Thompsonii* is known only from the environs of Mazon Creek in Will and Grundy Counties, Illinois. It is distinct from other *Macrostachya* cones collected at Cannelton, Beaver County, Pennsylvania. The geologic age of these forms is Upper Carboniferous, Allegheny Series, Kittanning formation.

I wish to acknowledge my gratitude to Lady Isabel Browne, Professor Walter Gothan, and Professor W.J. Jongmans for their generosity in presenting to me various publications relating to this study.

¹⁸Jongmans and Gothan: Geol. Bur. Heerlen Jaarverslag 1933, p.36.